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# SELECTIVE CONVERSION OF SOLAR ENERGY WITH RADIATION RESISTANT SOLAR ENERGY CONVERTER ARRAY

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## ABSTRACT OF THE DISCLOSURE

Selective conversion of solar energy to electrical energy in the presence of damaging nuclear radiation by use of a radiation resistant solar cell array having support wall structure arranged to shield cells from direct nuclear radiation and to reflect solar radiation onto the cell.

Natural radiation sources of penetrating particles are generally from random directions in space, such as cosmic, solar flare, particle and Van Allen radiation. Electromagnetic radiation, commonly called solar radiation, is predominantly unidirectional from the sun, reflectable, and is of interest here primarily for its visible radiation. Solar cell radiation shielding is conventionally provided to extend the life of solar cells, such as N on P silicon solar cells, which are exposed to the penetrating particle radiation to a degree sufficient to deteriorate the solar cell. Such radiation shielding is customarily provided by coverings of glass or quartz, usually as films or layers deposited on the solar cells. The protective layer provided by glass or quartz on the surface of solar cells allows electromagnetic radiation to pass through somewhat attenuated by the film material, and absorbs the penetrating particle radiation to the limit of the energy which it can contain in the thickness of protective shielding used. Such films pass a high proportion of the visible light, or the energetic electromagnetic radiation, but they do attenuate the desired radiation and they fail to take any advantage of directionality or reflectivity of electromagnetic radiation, which is normally utilized as an energy source for solar cells.

It is well known that solar cell materials are subject to substantial degradation under penetrating particle radiation but not under electromagnetic radiation. For this reason, glass or quartz shields, which may be 60 mils in thickness or more, may be bonded to the surface of a 10 to 12 mil thick solar cell to reduce particle radiation damage. Often the bonding materials, such as epoxy resins, are themselves sensitive to radiation in certain wavelengths; and, to protect the bonding materials, additional filter or shield material is often placed upon the glass or quartz shielding to filter out the radiation to which the bonding material is most sensitive, thus further reducing the transmission to the solar cell itself of the desired electromagnetic radiation. In the present invention advantage is taken of the fact that penetrating particle radiation does not reflect substantially from polished or mirror surfaces, and the desired electromagnetic radiation may be so reflected with efficiencies up to about 90 percent. Although the space environment will reduce reflection efficiency in time, reflection efficiencies in excess of 45 percent can be maintained over extended periods while subject to penetrating particle radiation damage.

Further advantage can be taken of the directionality of the desired radiation and the random direction of sources of particle radiation by removing the shield from the surface of the cell, or markedly reducing its thickness, and reflecting electromagnetic radiation from a reflective or polished surface to the cell behind the shield while

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maintaining the solar cell surface substantially protected by the shield from the direct penetrating particle radiation. This also makes possible the substitution of lighter and more effective material for the shielding which may also be a useful structural material. Such shields are no longer required to pass the electromagnetic radiation, from which the solar cell obtains its energy. This construction provides an unusually long lived solar cell.

Solar cells of silicon are generally preferred for their light weight, they have a specific gravity of about 2.3, and shielding materials of glass and quartz which are satisfactory for transmission of electromagnetic radiation have generally a specific gravity of about 3 to 4. The conventional glass or quartz shielded silicon solar cells are very heavy and provide an opportunity for a weight trade-off. Material such as aluminum or other metals may be used as a shield from particle radiation in lieu of the transparent films discussed, as a surface for reflection of electromagnetic radiation, or as a support for a reflective coating for such electromagnetic radiation, and as a physical support for the solar cells. Since the reduced reflectivity of a polished surface due to particle radiation damage has its parallel in the scattering effect of surface damage and loss of transmission of electromagnetic radiation in glass or quartz, the harmful effects of particle radiation are not peculiar to the reflective shielding system, and the amount of radiation energy reflected onto the cells may be predetermined by known radiation conditions and design.

Other advantages and characteristics of this invention will become apparent from the description and explanation of the invention. For consideration of what I believe to be novel and my invention, attention is directed to the following portion of this specification, including the drawings, which describes the invention and the manner and process of making and using it.

In the drawings, FIG. 1 shows a perspective view in partial cross section of a solar cell energy converter array utilizing reflected electromagnetic radiation according to this invention;

FIGS. 2, 3, 4 and 5 show alternate forms of the invention, partly in section;

FIG. 6 is a view in section of another alternate form of the invention which utilizes double reflection.

As shown in FIG. 1, an array according to this invention may comprise a series of extruded shapes **10** of a particle radiation shielding material such as aluminum supporting solar energy converter cells **11**, preferably silicon solar cells, in a manner substantially protecting the cells from direct penetrating particle radiation while exposing them to reflected electromagnetic radiation. A small percentage of direct radiation through an aperture **9** formed by the assembled shapes **10** may be tolerated but is not an objective of the array. A proportionately smaller amount of particle radiation entering the aperture, than electromagnetic radiation, will reach the solar cell because the electromagnetic radiation may be focused, and the particle radiation is from random directions. The series of supports **10** are arranged in an interlocking position to present a V-shaped recess to the source of electromagnetic radiation which enters the aperture of the assembly. The support structures have silicon-solar cells secured to one surface of the V in a plane substantially perpendicular to the opening and have the opposing surface of the V polished or coated to reflect electromagnetic radiation onto the solar cell surface. The solar cell **11**, here assumed to be of the silicon type, may present an edge to direct radiation through the aperture, or an additional portion **12** of shielding material may be placed along the edge to protect the silicon solar cell. The array of FIG. 1 is specially adapted for use in an oriented structure where the plane of solar cells as shown